INSTRUCTION NO. P12142

(Issue of 6/63)

CHANGING RANGE OF DYNAMASTER

RECORDING
INDICATING
CONTROLLING
TELEMETERING

INSTRUMENTS

BRISTOL'S

THE BRISTOL COMPANY
WATERBURY 20, CONN.

PLACE THESE INSTRUCTIONS WITH THE MAN IN CHARGE OF YOUR INSTRUMENTS

I M P O R T A N T

1. Read these instructions NOW before installing instrument.
2. Keep these instructions permanently & accessibly filed for future reference.
3. Be sure to specify MODEL & SERIAL numbers when ordering parts, instructions, diagrams or data.
4. Ship instruments or parts for repair or exchange only to Bristol's main or branch factories—not to Sales Offices.
5. Be sure to—
   1. Identify your shipments with your exact return address & order number.
   2. Write nearest Bristol Factory or office giving your order number, directions & address for return shipment, full instructions for repair, etc.
6. Report damage to shipments at once to shipping company. The *customer assumes responsibility for collecting any claim for damages* from the shipping company, on all shipments made on a collect basis.

WHO WILL SERVICE YOUR BRISTOL INSTRUMENT?

Divided responsibility produces misunderstanding and inattention. We therefore urge that all Bristol instruments in your plant be assigned to the care of one responsible man. He will rapidly become so familiar with routine chart changing, inking, checking and adjusting necessary to keep instruments in good working order, as to require only a few minutes time per day. Bristol will be pleased to supply additional information or personal instruction to instrument service men.

Instruction No. P12142
Issued 5/63

INSTRUCTION NO. P12142

(Issue of 6/63)

CHANGING RANGE OF DYNAMASTER MILLIVOLTMETERS AND PYROMETERS MODELS 560, 562, 565 AND 570

(WITH ZENER REFERENCE VOLTAGE SOURCE)

THE BRISTOL COMPANY WATERBURY 20, CONN.

PART I GENERAL INFORMATION

A. Measuring Circuit

Standard slide-wires are 175.6 ohms. The same slide-wire is used for all Models 560, 562, 565, and 570, and for any speed. All slide-wires are interchangeable.

All instruments built have a sliding trimmer resistor (8 ohms) mounted between the slide-wire and the calibrating resistors. This trimmer is marked "TR" on the wiring diagrams. It permits adjusting the calibration approximately plus or minus one half a per cent.

The reference source current is three milli-amperes and the reference voltage is 1.019 volts.

The calibrating resistors are mounted on a plate directly under the slide-wire on the back of the swinging panel. The resistors are each marked with a letter and their resistance value. The plate corresponds to the wiring diagram.

B. Reference Junction for Pyrometers

The reference junction resistor includes a small thermocouple mounted in close contact with the resistor element. This resistor, which is marked "D", is mounted on the plate with the other calibrating resistors on all single point recorders.

The reference junction uses a special assembly (see Fig. 2) for multiples. The thermocouple extension wire is used only between the terminal block and the compensator. Copper wires are used from the compensator to the rotary switch, and from the rotary switch to the calibrating resistors.

PART II CHANGING RANGE

A. Changing Scales

To change scale on strip chart recorders Model 560 and 570:

1. Turn off instrument.

2. Remove the four screws holding the scale and remove the scale.

3. Mount new scale but do not tighten screws.

4. Run pointer to left end of scale by moving the large gear behind the scale. On single-point recorders, line up the pen with the last solid line on the chart. On multiple-point recorders line up the dot with the last solid line on the chart.

5. Adjust scale so that the last line on the left of the scale lines up with the pointer. Tighten screws holding scale.

To change scale on round chart recorder Model 565:

1. Turn off instrument.

2. Remove the four nuts at the four corners on the inside of the door.

3. Remove glass and frame from front of door.

4. Remove four screws which hold the scale.

5. Install new scale but do not tighten the four screws.

6. Adjust scale until it is concentric with the sweep of the pointer. Then tighten the four screws.

7. Set pen at bottom line of chart by moving large gear behind the chart plate.

8. If pointer does not line up with bottom line of scale, remove pointer by pulling forward on the pointer hub.

9. Loosen the two screws on the back of the pointer hub.

10. Replace pointer.

11. Adjust pointer until it lines up with bottom line on scale.

12. Remove pointer and tighten screws.

13. Replace pointer and cheek at several points on scale.

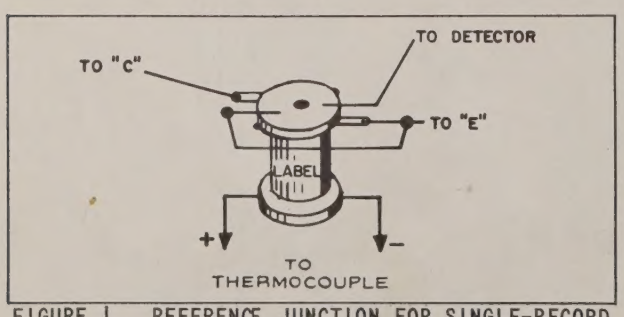


FIGURE 1. REFERENCE JUNCTION FOR SINGLE-RECORD INSTRUMENTS

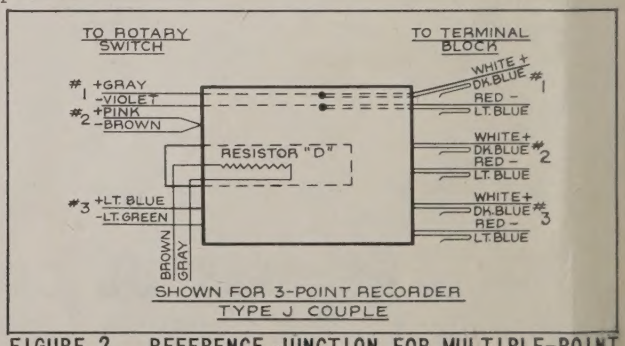


FIGURE 2. REFERENCE JUNCTION FOR MULTIPLE-POINT RECORDERS.

To change scale on Precision Indicator Model 562:

1. Turn off instrument.

2. Open hinged panel.

3. Remove the three screws which hold the indicator drum. These are located on the top of the drum.

4. Remove the drum from the instrument.

5. Remove the scale from the drum by removing the screws.

6. Mount the new drum on the scale.

7. Install the drum in the instrument and replace the three mounting screws, but do not tighten.

8. Push top of large gear to the left until the gear hits the stop.

9. Line up the lowest line of the indicator scale with the pointer, and then tighten the three screws.

B. Changing Measuring Circuit Resistors

All standard range Dynamasters are equipped with a plug-in spool card. The range may be changed by purchasing a whole new card or by changing the individual spools as explained below.

1. Determine resistors to be changed by comparing resistors required on present range, to resistors required on new range.

2. Determine the position of the resistors to be changed by consulting the wiring diagram.

3. Remove cover from resistor panel by loosening the two thumb screws.

4. Unsolder and remove the resistors to be changed. Note - the resistor replacing the one removed should have the same letter designation.

5. Carefully solder the new resistor in place.

6. Set the slider on the trimmer at the mid-point.

7. Connect portable potentiometer to instrument and turn on instrument.

8. Set portable potentiometer for 10% of scale. Check sensitivity of recorder by moving pen upscale and allowing instrument to rebalance. Then move pen down-scale and allow instrument to rebalance. Note the dead band. It should be between 0.1 and .05% of full scale. If dead band is greater than 0.1%, turn gain control on amplifier clockwise until dead band is correct. If dead band is less than .05%, turn gain control counterclockwise until dead band is correct.

Adjust pen and pointer to read correctly at this point. Do this by loosening the two screws on the top of the pen carriage which clamp the drive cord to the pen carriage. When pen is correct, tighten screws in clamp.

9. Set portable potentiometer at 80% of scale. If pen or pointer reads low, loosen slider on trimmer and move slider to left until pen is correct. Tighten slider and check calibration at several more points on scale. If pen on pointer reads high, move slider on trimmer to right.

C. Changing the Reference Junction Resistor

If the new range is for a type of thermocouple different from that of the original range, the reference junction resistor "D" will have to be changed.

On single-point recorders:

1. Remove screw, raise spool to unsolder connection to "D" resistor.

2. Replace it with the new resistor for the proper thermocouple. Replace the thermocouple extension between resistor "D" and the terminal block with the proper extension wire (refer to table below) for the new couple. See Figure 1 for proper polarity of resistor.

On multiple-point recorders:

These are equipped with a universal reference junction. (See Fig. 2). It is mounted on the back of the case above the terminal blocks. If the new range is for a different type of thermocouple, it is not necessary to change the reference junction, switch assembly, cable or reference junction resistor "D".

A compensator resistor of 12 ohms of nickel wire is built into the reference junction. The current is changed in this resistor when different couples are used. This is done when the resistance spools are calculated. Be sure that the range card used is for a multiple-point instrument. The current used for the various curves is as follows:

0.85 m.a. for the J Curve
0.6583 m.a. for the K curve
0.675 m.a. for the T curve
0.100 m.a. for the S curve

It is necessary to see that the proper thermocouple wires are used between the terminal block and the rotary switch.

CURVE DESIGNATION		"D" RESISTANCE IN OHMS
Bristol	I.S.A.	
27 of 32	S or R	2.400
IC	J	20.40
25H	K	15.80
24B	T	16.20

All of the compensating wires needed for the various thermocouples, are permanently installed in the reference junction. The wires not in use are taped back on the cable. Connect the proper color coded wires to the terminal block, as indicated in the table on page 4. Tape back the unused wires.

COUPLE	POSITIVE	NEGATIVE
Iron-Constantan	White	Red
Copper-Constantan	Dark Blue	Red
Platinum Rhodium-Platinum	Dark Blue	Light Blue
Chromel Alumel	Dark Blue	Red

D. Change Nameplate

The nameplate is located on the inside of the door. A new nameplate should always be installed giving the new range information.

E. How to Calculate Measuring Circuit for Millivoltmeter Potentiometers single and multiple record

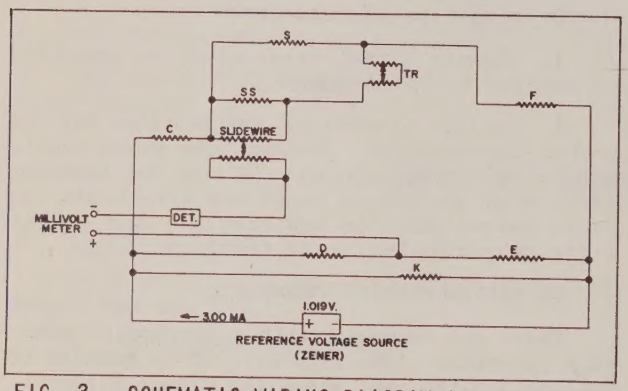


FIG. 3. SCHEMATIC WIRING DIAGRAM OF MILLIVOLTMETER MEASURING CIRCUIT.

X = Parallel resistance of slide-wire, SS and (S + TR)

SS = Shunt resistor mounted on slide-wire disk

S = Shunt resistor used to control span

TR = Trimmer resistor used for fine adjustment of calibration

b = Millivolts at low end of range

C = Bridge resistor

D = Bridge resistor

F = Bridge resistor

E = Bridge resistor

M = Span in millivolts

K = Loading resistor

Z = Slide-wire factor (1.0565)

336° = Active angle of slidewire

338° = Angle between stops

347.8° = Total angle of slidewire

5.9° = Angle of low end overhang of slidewire 1.56% Slidewire 175.6 OHMS

Dma = 0.5

Xma = Current through slidewire branch
Use .5 for Ranges up to 50 Millivolts
Use 1.0 for Ranges 50 to 100 Millivolts
Use 2.5 for Ranges 100 to 400 Millivolts

When "b" is greater than zero

$$X = \frac{M\ (Z)}{Xma}$$

$$D = 20.00\ \text{OHMS}$$

$$C = \frac{20\ (Dma) + b}{Xma} - .0156X$$

$$E = \frac{1019}{Dma} - D$$

$$F = \frac{1019}{Xma} - C - X$$

$$S = \frac{(\text{Slidewire} + 1/2\ TR)\ (X)}{\text{Slidewire} + 1/2\ TR - X}$$

$$K = \frac{1019}{3 - Xma - Dma}$$

Example: 50 to 100 M.V.

$$X = \frac{50\ (1.0565)}{1.0} = \frac{52.825}{1.0} = 52.825$$

$$D = 20.00$$

$$C = \frac{20(.5) + 50}{.5} - .0156(52.825) = \frac{10 + .50}{.5} - .824$$

$$C = 29.176$$

$$E = \frac{1019}{.5} - D = 2038 - 20 = 2018$$

$$F = \frac{1019}{1.0} - 29.176 - 52.825 = 936.999$$

$$S = \frac{(175.6 + 4)\ 52.825}{(175.6 + 4) - 52.825} = \frac{9487.37}{126.775} = 74.836$$

$$K = \frac{1019}{3 - 1.0 - 0.5} = \frac{1019}{1.5} = 679.33$$

When "b" is zero or less

$$X = \frac{M\ (Z)}{Xma}$$

$$D = \frac{-b}{Dma} + 20$$

$$C = \frac{D\ (Dma) + b}{Xma} - .0156X$$

$$E = \frac{1019}{Dma} - D$$

$$F = \frac{1019}{Xma} - C - X$$

$$S = \frac{(\text{Slidewire} + 1/2\ TR)\ (X)}{\text{Slidewire} + 1/2\ TR - X}$$

$$K = \frac{1019}{3 - Xma - Dma}$$

Example: 0 to 10 M.V.

$$X = \frac{10\ (1.0565)}{.5} = \frac{10.565}{.5} = 21.130$$

$$D = \frac{-0}{0.5} + 20 = 20$$

$$C = \frac{20\ (.5) + 0}{.5} - .0156\ (21.130) = 20 - 0.330 = 19.670$$

$$E = \frac{1019}{.5} - 20 = 2038 - 20 = 2018$$

$$F = \frac{1019}{.5} - 19.670 - 21.130 = 1997.20$$

$$S = \frac{(175.6 + 4)\ (21.130)}{175.6 + 4 - 21.130} = \frac{3794.948}{158.47} = 23.947$$

$$K = \frac{1019}{3 - .5 - .5} = \frac{1019}{2} = 509.5$$

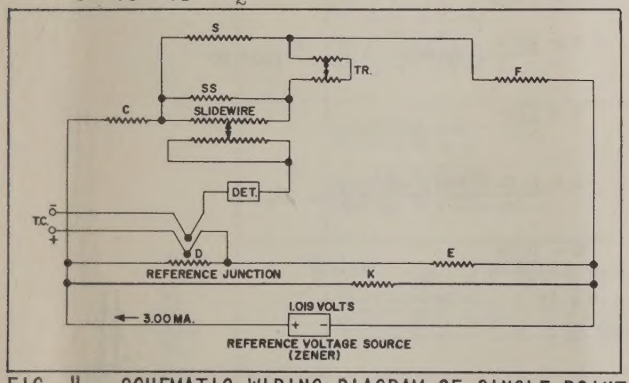


FIG. 4. SCHEMATIC WIRING DIAGRAM OF SINGLE POINT PYROMETER.

F. How to Calculate Measuring Circuit for Single Record Pyrometers

X = Parallel resistance of slide-wire, SS and (S + TR)

SS = Shunt resistor mounted on slide-wire disk

S = Shunt resistor used to control span

TR = Trimmer resistor used for fine adjustment of calibration

b = Millivolts at low end of range

C = Bridge resistor

D = Bridge resistor

F = Bridge resistor

E = Bridge resistor

M = Span in millivolts

K = Loading resistor (used to load Zener to exactly 3.000 M.A.)

Z = Slide-wire factor (1.0565)

Slide-wire 175.6 OHMS

336° = Active angle of slidewire

338° = Angle between stops

347.8° = Total angle of slidewire

5.9° = Angle of low end overhang of slidewire 1.56%

D = 2.400 OHMS for T.C. Type R or S

D = 20.400 OHMS for T.C. Type J

D = 15.800 OHMS for T.C. Type K

D = 16.200 OHMS for T.C. Type T

Xma = Current through slidewire branch
Use 0.5 for ranges up to 50 Millivolts
Use 1.0 for ranges 50 to 100 Millivolts
Use 2.5 for ranges 100 to 400 Millivolts

Dma = 0.5

$$X = \frac{M\ (Z)}{Xma}$$

$$C = \frac{D\ (Dma) + b}{Xma} - .0156X$$

$$F = \frac{1019}{Xma} - X - C$$

$$E = \left(\frac{1019}{Dma}\right) D$$

$$S = \frac{(\text{Slidewire} + 1/2\ TR)\ (X)}{(\text{Slidewire} + 1/2\ TR) - X}$$

$$K = \frac{1019}{3 - Xma - Dma}$$

Example: 0-1000°F Type J Couple

0°F = -2.11 M.V. 1000°F = +28.30 M.V.

M = 28.30 + 2.11 = 30.41 M.V.

$$X = \frac{30.41\ (1.0565)}{0.5} = 64.256$$

$$C = \frac{(20.4)\ (0.5) - 2.11}{(0.5)} - .0156\ (64.256) = 16.18 - 1.002$$

C = 15.178

$$F = \frac{1019}{0.5} - 64.256 - 15.178 = 1958.6$$

$$E = \frac{1019}{0.5} - 20.4 = 2017.6$$

$$S = \frac{(175.6 + 4)\ (64.256)}{(175.6 + 4) - 64.256} = \frac{11540.38}{115.34} = 100.052$$

$$K = \frac{1019}{3 - .5 - .5} = \frac{1019}{2} = 509.5$$

G. How to Calculate Measuring Circuit for Multiple Point Pyrometers

Xma = Current through slide-wire branch
Use 0.5 for ranges up to 50 M.V.
Use 1.0 for ranges 50 to 100 M.V.
Use 2.5 for ranges 100 to 400 M.V.

D = 11.85 OHMS Nickel plus 0.15 OHMS copper leads = 12.00 OHMS

Use D = 12.000 OHMS for calculations

Use Dma = 0.85 for J Curve
Dma = 0.6583 for K Curve
Dma = 0.675 for T Curve
Dma = 0.100 for S Curve

$$X = \frac{M\ (Z)}{Xma}$$

$$C = \frac{D\ (Dma) + b}{Xma} - .0156X$$

$$F = \frac{1019}{Xma} - X - C$$

$$E = \frac{1019}{Dma} - D$$

$$S = \frac{(\text{Slide-wire} + 1/2\ TR)\ (X)}{(\text{Slide-wire} + 1/2\ TR) - X}$$

$$K = \frac{1019}{3 - Xma - Dma}$$

Example: 0-1000°F Type J Couple

$0°F = -2.11$ M.V. $\quad 1000°F = +28.30$ M.V.

$M = 28.30 + 2.11 = 30.41$ M.V.

$$X = \frac{30.41\ (1.0565)}{0.5} = 64.256$$

$$C = \frac{12.00\ (0.85) - 2.11}{0.5} - .0156\ (64.256)$$

$C = 16.18 - 1.002 = 15.178$

$$F = \frac{1019}{0.5} - X - C = 2038 - 64.256 - 15.178 = 1958.57$$

$$E = \frac{1019}{0.85} - 12.00 = 1198.82 - 12.00 = 1186.82$$

$$S = \frac{(175.6 + 4)\ (64.256)}{175.6 + 4 - 64.256} = 100.052$$

$$K = \frac{1019}{3 - 0.5 - 0.85} = 617.576$$

Example: 0-3000°F Type S Couple

$0°F = -0.236 \quad 3000°F = +17.156$

$M = 17.156 + 0.236 = 17.392$

$$X = \frac{17.392\ (1.0565)}{0.5} = 36.750$$

$$C = \frac{12.00\ (0.100) - 0.236}{0.5} - .0156\ (36.750)$$

$C = 1.928 - .573 = 1.355$

$$F = \frac{1019}{0.5} - 36.750 - 1.355 = 1999.89$$

$$E = \frac{1019}{0.10} - D = 10178.0$$

$$S = \frac{(175.6 + 4)\ (36.750)}{175.6 + 4 - 36.750} = 46.204$$

$$K = \frac{1019}{3 - 0.5 - 0.1} = 424.58$$

MILLIVOLTMETER

SINGLE OR MULTIPLE POINT

WIRING DIAGRAM	RANGE	C	S	F	D	E	M	G	K	FS FAILSAFE UP	FS FAILSAFE DOWN
018343	0-1	0		839.40	28.000	10162	200.00	33612	536.32	300 MEG.	4.7 MEG.
"	0-2	0		839.40	28.000	10162	400.00	33412	536.32	150 "	2.2 "
"	0-2.5	0		839.40	28.000	10162	500.00	33312	536.32	120 "	1.8 "
"	0-3	0		839.40	28.000	10162	600.00	33212	536.32	100 "	1.5 "
"	0-4	0		839.4	28.000	10162	800.00	33012	536.32	82 "	1.2 "
"	0-5	0		839.4	28.000	10162	1000.0	32812	536.32	68 "	1.0 "
"	0-7.5	19.753	17.382	2002.4	20.000	2018.0			509.50	47 "	470 K
018216	0-8	19.736	18.660	2001.4	20.000	2018.0			509.50	39 "	300 K
"	0-10	19.670	23.947	1997.2	20.000	2018.0			509.50	33 "	270 K
"	0-15	19.506	38.486	1986.8	20.000	2018.0			509.50	22 "	220 K
"	0-20	19.341	55.264	1976.4	20.000	2018.0			509.50	15 "	150 K
"	0-25	19.176	74.833	1966.0	20.000	2018.0			509.50	12 "	130 K
"	0-30	19.011	97.968	1955.6	20.000	2018.0			509.50	10 "	110 K
"	0-40	18.681	159.65	1934.8	20.000	2018.0			509.50	8.2 "	82 K
"	0-50	18.352	256.59	1914.0	20.000	2018.0			509.50	6.8 "	68 K
"	0-60	9.0110	97.968	946.60	20.000	2018.0			679.33	5.6 "	47 K
"	0-75	8.7640	141.80	931.00	20.000	2018.0			679.33	3.9 "	33 K
"	0-80	8.681	159.65	925.80	20.000	2018.0			679.33	3.3 "	33 K
"	1-100	8.352	256.59	905.00	20.000	2018.0			679.33	2.7 "	22 K
"	0-150	3.0111	97.968	341.20	20.000	2018.0			-	2.2 "	22 K
"	0-200	2.6815	159.65	320.40	20.000	2018.0			-	1.5 "	15 K
"	0-300	2.0222	431.08	278.80	20.000	2018.0			-	1.0 "	10 K
"	-10 to +10	19.341	55.264	1976.4	40.000	1998.0			509.5	15 "	300 K
"	-100 to +100	8.6815	159.65	314.40	250.00	1788.0			-	1.5 "	150 K

PYROMETER

SINGLE RECORD THERMOCOUPLE TYPE J

WIRING DIAGRAM	RANGE	C	S	F	D	E	M	G	K	DI	EI	FS FAILSAFE UP	FS FAILSAFE DOWN
018336	0-150°F	5.2900		834.11	20.400	2017.6	779.70	32980	727.86	80.900	10109	68 MEG.	1 MEG.
018211	0-200°F	15.989	13.152	2009.8	20.400	2017.6			509.50			56 "	680 K.
"	0-250°F	15.939	16.900	2006.6	20.400	2017.6			509.50			47 "	470 K.
"	0-300°F	15.889	20.821	2003.5	20.400	2017.6			509.50			39 "	300 K.
"	0-400°F	15.787	29.296	1997.0	20.400	2017.6			509.50			27 "	270 K.
"	0-500°F	15.685	38.519	1990.6	20.400	2017.6			509.50			22 "	240 K.
"	0-600°F	15.584	48.490	1984.2	20.400	2017.6			509.50			18 "	220 K.
"	0-1000°F	15.178	100.06	1958.6	20.400	2017.6			509.50			12 "	130 K.
"	0-1500°F	14.617	226.65	1923.2	20.400	2017.6			509.50			6.8 "	68 K.
"	0-2000°F	14.037	584.58	1886.6	20.400	2017.6			509.50			4.7 "	47 K.
018211	0-100°C	17.666	11.872	2009.2	20.400	2017.6			509.50			56 MEG.	680 K.
"	0-150°C	17.576	18.660	2003.5	20.400	2017.6			509.50			39 "	470 K.
"	0-200°C	17.485	26.087	1997.7	20.400	2017.6			509.50			27 "	300 K.
"	0-500°C	16.937	85.389	1963.2	20.400	2017.6			509.50			12 "	130 K.
"	0-600°C	16.749	114.60	1951.3	20.400	2017.6			509.50			10 "	110 K.
"	0-800°C	16.339	207.19	1925.5	20.400	2017.6			509.50			6.8 "	68 K.

PYROMETER

MULTIPLE RECORD THERMOCOUPLE TYPE J

WIRING DIAGRAM	RANGE	C	S	F	D	E	M	G	K	DI	EI
018336-12	0-150°F	5.2900		834.11	11.850	1186.8	779.70	32980	657.40	80.900	10109
018211-12	0-200°F	15.989	13.152	2009.8	11.850	1186.8			617.58		
"	0-250°F	15.939	16.900	2006.6	11.850	1186.8			617.58		
"	0-300°F	15.889	20.821	2003.5	11.850	1186.8			617.58		
"	0-400°F	15.787	29.296	1997.0	11.850	1186.8			617.58		
"	0-500°F	15.685	38.519	1990.6	11.850	1186.8			617.58		
"	0-600°F	15.584	48.490	1984.2	11.850	1186.8			617.58		
"	0-1000°F	15.178	100.06	1958.6	11.850	1186.8			617.58		
"	0-1500°F	14.617	226.65	1923.2	11.850	1186.8			617.58		
"	0-2000°F	14.037	584.58	1886.6	11.850	1186.8			617.58		
018211-12	0-100°C	17.666	11.872	2009.2	11.850	1186.8			617.58		
"	0-150°C	17.576	18.660	2003.5	11.850	1186.8			617.58		
"	0-200°C	17.485	26.087	1997.7	11.850	1186.8			617.58		
"	0-500°C	16.937	85.389	1963.2	11.850	1186.8			617.58		
"	0-600°C	16.749	114.60	1951.3	11.850	1186.8			617.58		
"	0-800°C	16.339	207.19	1925.5	11.850	1186.8			617.58		

PYROMETER

SINGLE RECORD THERMOCOUPLE TYPE K

WIRING DIAGRAM	RANGE	C	S	F	D	E	M	G	K	FS FAILSAFE UP	FS FAILSAFE DOWN
018211	0-600°F	12.094	34.031	1997.3	15.800	2022.2			509.50	222 MEG.	220 K.
"	0-800°F	11.940	48.970	1987.6	15.800	2022.2			509.50	18 "	130 K.
"	0-1000°F	11.784	66.389	1977.7	15.800	2022.2			509.50	15 "	110 K.
"	0-1200°F	11.628	86.644	1967.9	15.800	2022.2			509.50	12 "	82 K.
"	0-1500°F	11.399	123.36	1953.5	15.800	2022.2			509.50	10 "	68 K.
"	0-1600°F	11.325	137.59	1948.8	15.800	2022.2			509.50	8.2 "	68 K.
"	0-1800°F	11.179	169.75	1939.6	15.800	2022.2			509.50	8.2 "	47 K.
"	0-2000°F	11.037	207.78	1930.6	15.800	2022.2			509.50	6.8 "	47 K.
"	0-2500°F	10.707	339.66	1909.8	15.800	2022.2			509.50	5.6 "	47 K.
018211	0-200°C	13.532	18.996	2007.3	15.800	2022.2			509.50	39 MEG.	300 K.
"	0-250°C	13.465	24.383	2003.1	15.800	2022.2			509.50	33 "	270 K.
"	0-400°C	13.259	42.937	1990.1	15.800	2022.2			509.50	22 "	150 K.
"	0-500°C	13.119	57.634	1981.2	15.800	2022.2			509.50	15 "	130 K.
"	0-600°C	12.979	74.453	1972.4	15.800	2022.2			509.50	12 "	110 K.
"	0-800°C	12.702	115.68	1954.9	15.800	2022.2			509.50	10 "	82 K.
"	0-1000°C	12.438	169.83	1938.3	15.800	2022.2			509.50	8.2 "	68 K.
"	0-1200°C	12.189	243.15	1922.5	15.800	2022.2			509.50	6.8 "	47 K.
"	0-1400°C	11.956	345.92	1907.8	15.800	2022.2			509.50	5.6 "	47 K.

PYROMETER

MULTIPLE RECORD THERMOCOUPLE TYPE K

WIRING DIAGRAM	RANGE	C	S	F	D	E	M	G	K
018211-12	0-600°F	12.094	34.031	1997.3	11.850	1535.9			553.29
"	0-800°F	11.940	48.970	1987.6	11.850	1535.9			553.29
"	0-1000°F	11.784	66.389	1977.7	11.850	1535.9			553.29
"	0-1200°F	11.628	86.644	1967.9	11.850	1535.9			553.29
"	0-1500°F	11.399	123.36	1953.5	11.850	1535.9			553.29
"	0-1600°F	11.325	137.59	1948.8	11.850	1535.9			553.29
"	0-1800°F	11.179	169.75	1939.6	11.850	1535.9			553.29
"	0-2000°F	11.037	207.78	1930.6	11.850	1535.9			553.29
"	0-2500°F	10.707	339.66	1909.8	11.850	1535.9			553.29
018211-12	0-200°C	13.532	18.996	2007.3	11.850	1535.9			553.29
"	0-250°C	13.465	24.383	2003.1	11.850	1535.9			553.29
"	0-400°C	13.259	42.937	1990.1	11.850	1535.9			553.29
"	0-500°C	13.119	57.634	1981.2	11.850	1535.9			553.29
"	0-600°C	12.979	74.453	1972.4	11.850	1535.9			553.29
"	0-800°C	12.702	115.68	1954.9	11.850	1535.9			553.29
"	0-1000°C	12.438	169.83	1938.3	11.850	1535.9			553.29
"	0-1200°C	12.189	243.15	1922.5	11.850	1535.9			553.29
"	0-1400°C	11.956	345.92	1907.8	11.850	1535.9			553.29

PYROMETER

SINGLE RECORD THERMOMETER TYPE T

WIRING DIAGRAM	RANGE	C	S	F	D	E	M	G	K	DI	EI	FS FAILSAFE UP	FS FAILSAFE DOWN
018336	0-150°F	3.6860		835.71	16.200	2021.8	611.74	33164	727.86	64.860	10125	82 MEG.	1 MEG.
"	0-200°F	3.6860		835.71	16.200	2021.8	862.90	32913	727.86	64.860	10125	68 "	680 K.
018211	0-250°F	12.776	13.518	2012.7	16.200	2021.8			509.50			56 "	470 K.
"	0-300°F	12.731	16.917	2009.8	16.200	2021.8			509.50			47 "	300 K.
"	0-400°F	12.636	24.478	2003.8	16.200	2021.8			509.50			33 "	240 K.
"	0-500°F	12.535	33.154	1997.5	16.200	2021.8			509.50			27 "	220 K.
"	0-800°F	12.207	67.425	1976.8	16.200	2021.8			509.50			15 "	110 K.
"	-25 to +125°F	3.1850		836.22	16.200	2021.8	596.10	33184	727.86	59.850	10130	100 "	1 MEG.
018336	0-100°C	4.3100		835.09	16.200	2021.8	784.80	32985	727.86	71.10	10119	82 MEG.	680 K.
018211	0-150°C	13.999	15.375	2009.5	16.200	2021.8			509.50			47 "	470 K.
"	0-200°C	13.914	22.034	2004.5	16.200	2021.8			509.50			33 "	270 K.
"	0-300°C	13.730	38.065	1992.9	16.200	2021.8			509.50			22 "	220 K.

PYROMETER

MULTIPLE RECORD THERMOCOUPLE TYPE T

WIRING DIAGRAM	RANGE	C	S	F	D	E	M	G	K	DI	EI
018336-12	0-150°F	3.6860		835.71	11.850	1497.6	611.74	33164	590.72	64.860	10125
"	0-200°F	3.6860		835.71	11.850	1497.6	862.90	32913	590.72	64.860	10125
018211-12	0-250°F	12.776	13.518	2012.7	11.850	1497.6			558.36		
"	0-300°F	12.731	16.917	2009.8	11.850	1497.6			558.36		
"	0-400°F	12.636	24.478	2003.8	11.850	1497.6			558.36		
"	0-500°F	12.535	33.154	1997.5	11.850	1497.6			558.36		
"	0-800 °F	12.207	67.425	1976.8	11.850	1497.6			558.36		
"	-25 to + 125°F	3.1850		836.22	11.850	1497.6	596.10	33184	590.72	59.850	10130
018336-12	0-100°C	4.3100		835.09	11.850	1497.6	784.80	32985	590.72	71.10	10119
018211-12	0-150°C	13.999	15.375	2009.5	11.850	1497.6			558.36		
"	0-200°C	13.914	22.034	2004.5	11.850	1497.6			558.36		
"	0-300°C	13.730	38.065	1992.9	11.850	1497.6			558.36		

PYROMETER

SINGLE RECORD THERMOCOUPLE TYPE S

WIRING DIAGRAM	RANGE	C	S	F	D	E	K	FS FAILSAFE	
								UP	DOWN
018211	0-1500°F	1.6775	17.631	2020.3	2.4000	2035.6	509.50	39 MEG.	47 K.
"	0-3000°F	1.3547	46.203	1999.9	2.4000	2035.6	509.50	18 MEG.	33 K.
"	0-3200°F	1.3119	50.623	1997.2	2.4000	2035.6	509.50	15 MEG.	22 K.
018211	0-1000°C	1.7986	22.786	2016.0	2.4000	2035.6	509.50	33 MEG.	47 K.

PYROMETER

MULTIPLE RECORD THERMOCOUPLE TYPE S

WIRING DIAGRAM	RANGE	C	S	F	D	E	K
018211-12	0-1500°F	1.6775	17.631	2020.3	11.85	10178	424.58
"	0-3000°F	1.3547	46.203	1999.9	11.85	10178	424.58
"	0-3200°F	1.3119	50.623	1997.2	11.85	10178	424.58
018211-12	0-1000°C	1.7986	22.786	2016.0	11.85	10178	424.58

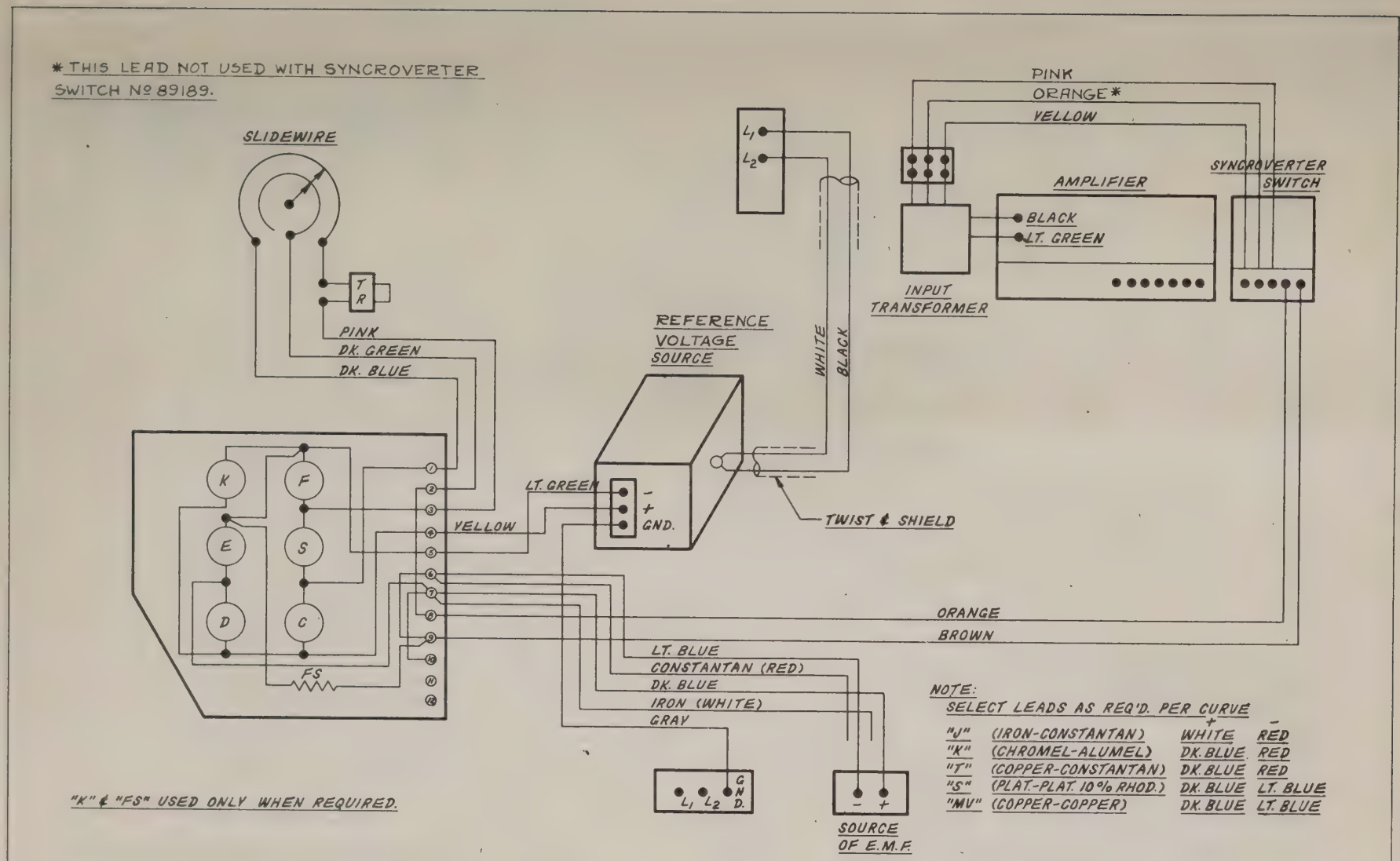
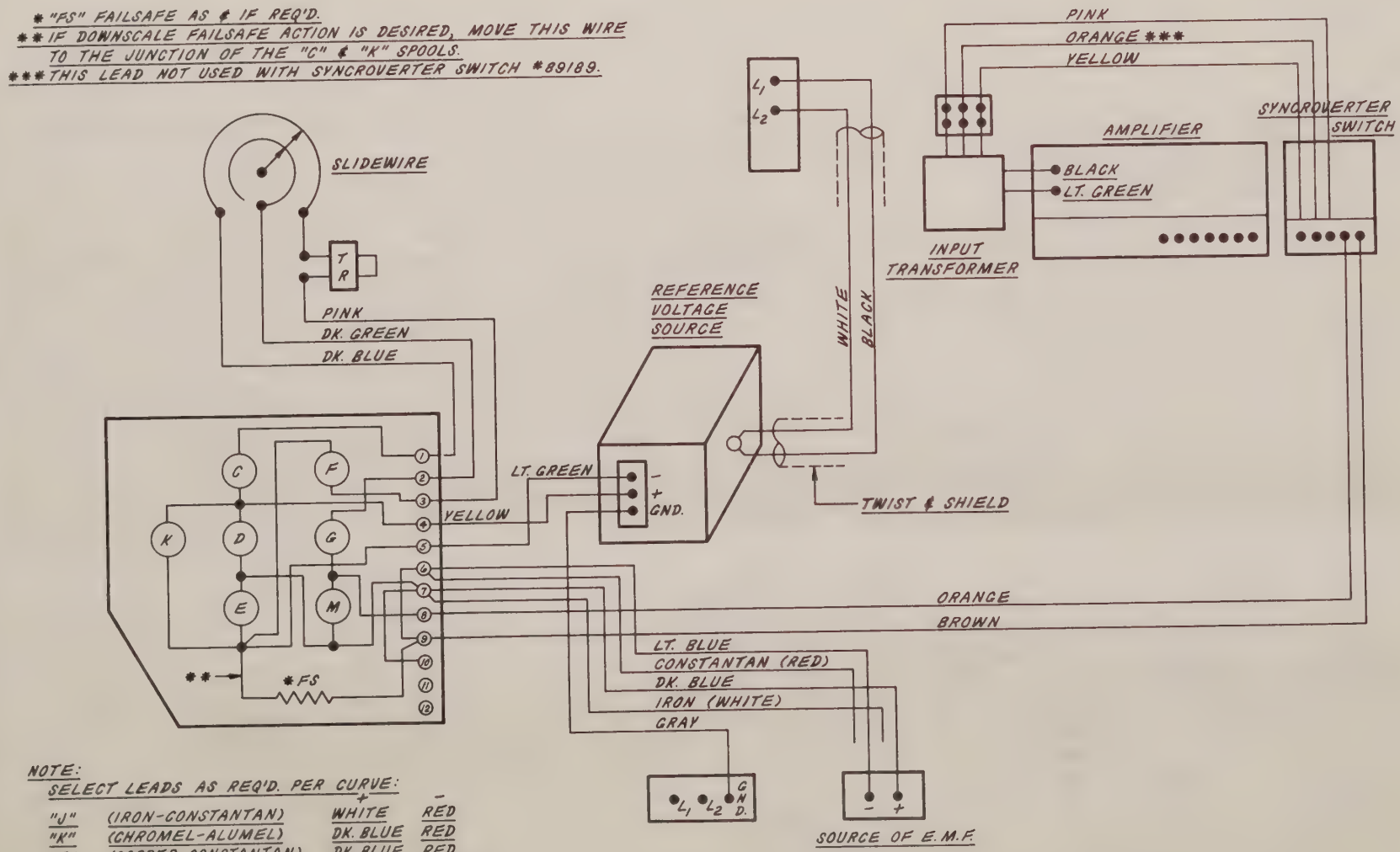


FIGURE 5. MEASURING CIRCUIT WIRING FOR SINGLE-POINT MILLIVOLTMETER WITH VOLTAGE REFERENCE SOURCE.



NOTE:
SELECT LEADS AS REQ'D. PER CURVE:

		+	−
"J"	(IRON-CONSTANTAN)	WHITE	RED
"K"	(CHROMEL-ALUMEL)	DK. BLUE	RED
"T"	(COPPER-CONSTANTAN)	DK. BLUE	RED
"S"	(PLAT.-PLAT. 10% RHOD.)	DK. BLUE	LT. BLUE
"MV"	(COPPER-COPPER)	DK. BLUE	LT. BLUE

FIGURE 6. MEASURING CIRCUIT WIRING FOR SINGLE-POINT MILLIVOLTMETER DIVIDER BRIDGE WITH REFERENCE VOLTAGE SOURCE.

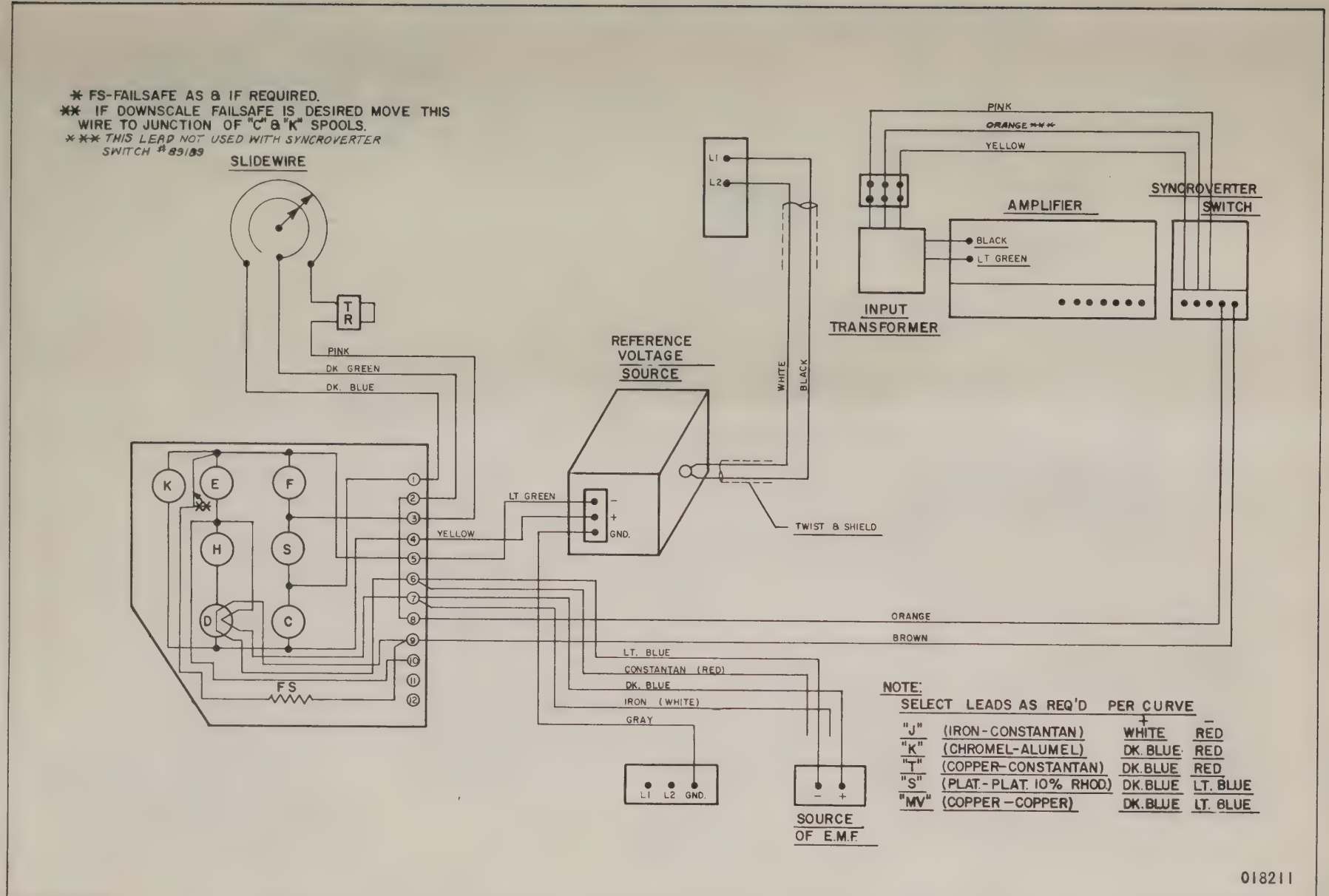
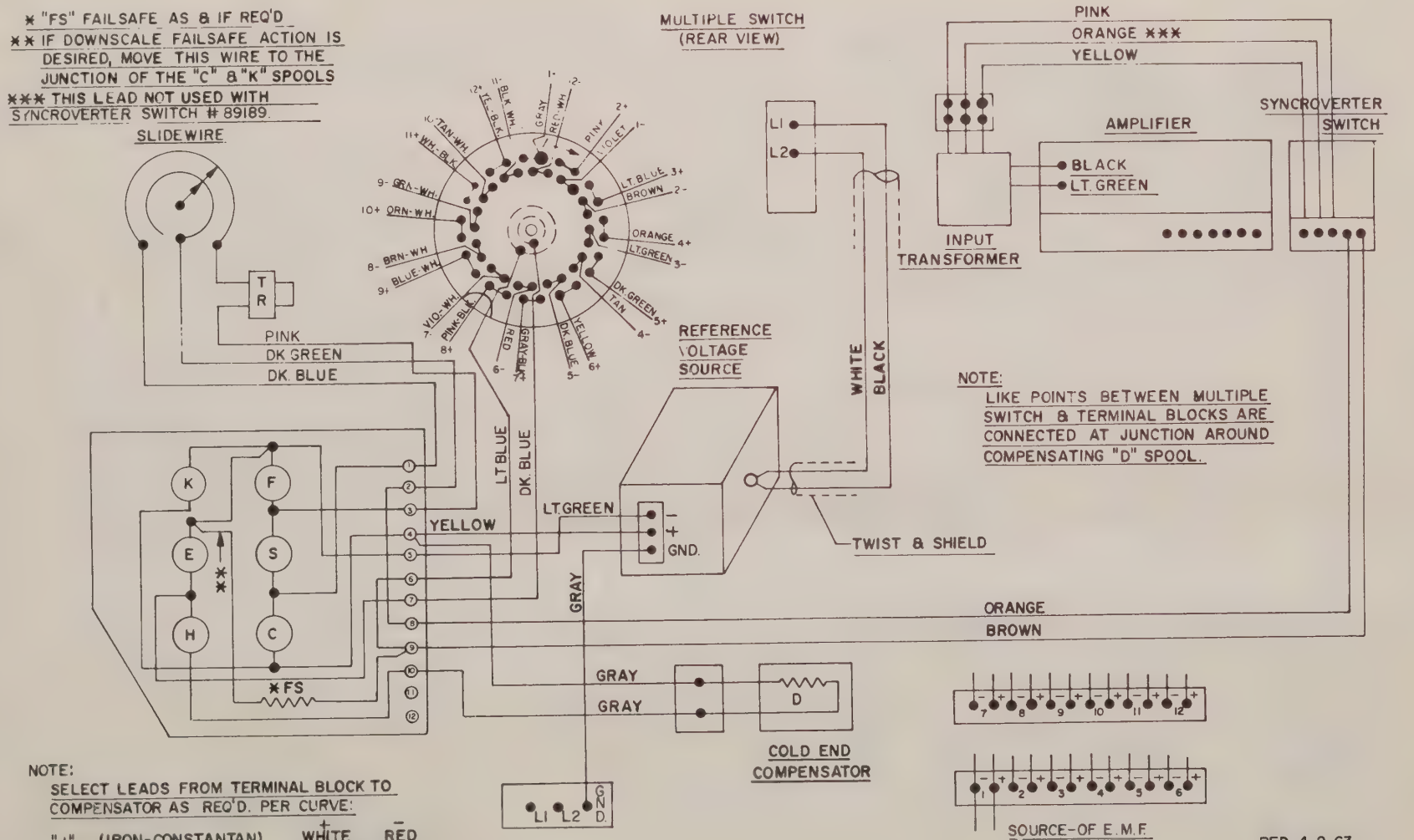


FIGURE 7. MEASURING CIRCUIT WIRING FOR SINGLE-POINT PYROMETER WITH VOLTAGE REFERENCE SOURCE.



NOTE:
SELECT LEADS FROM TERMINAL BLOCK TO COMPENSATOR AS REQ'D. PER CURVE:

		+	−
"J"	(IRON-CONSTANTAN)	WHITE	RED
"K"	(CHROMEL-ALUMEL)	DK. BLUE	RED
"T"	(COPPER-CONSTANTAN)	DK. BLUE	RED
"S"	(PLAT.-PLAT. 10% RHOD.)	DK. BLUE	LT. BLUE
"MV"	(COPPER-COPPER)	DK BLUE	LT. BLUE

FIGURE 8. MEASURING CIRCUIT FOR 12-POINT PYROMETER WITH REFERENCE VOLTAGE SOURCE.

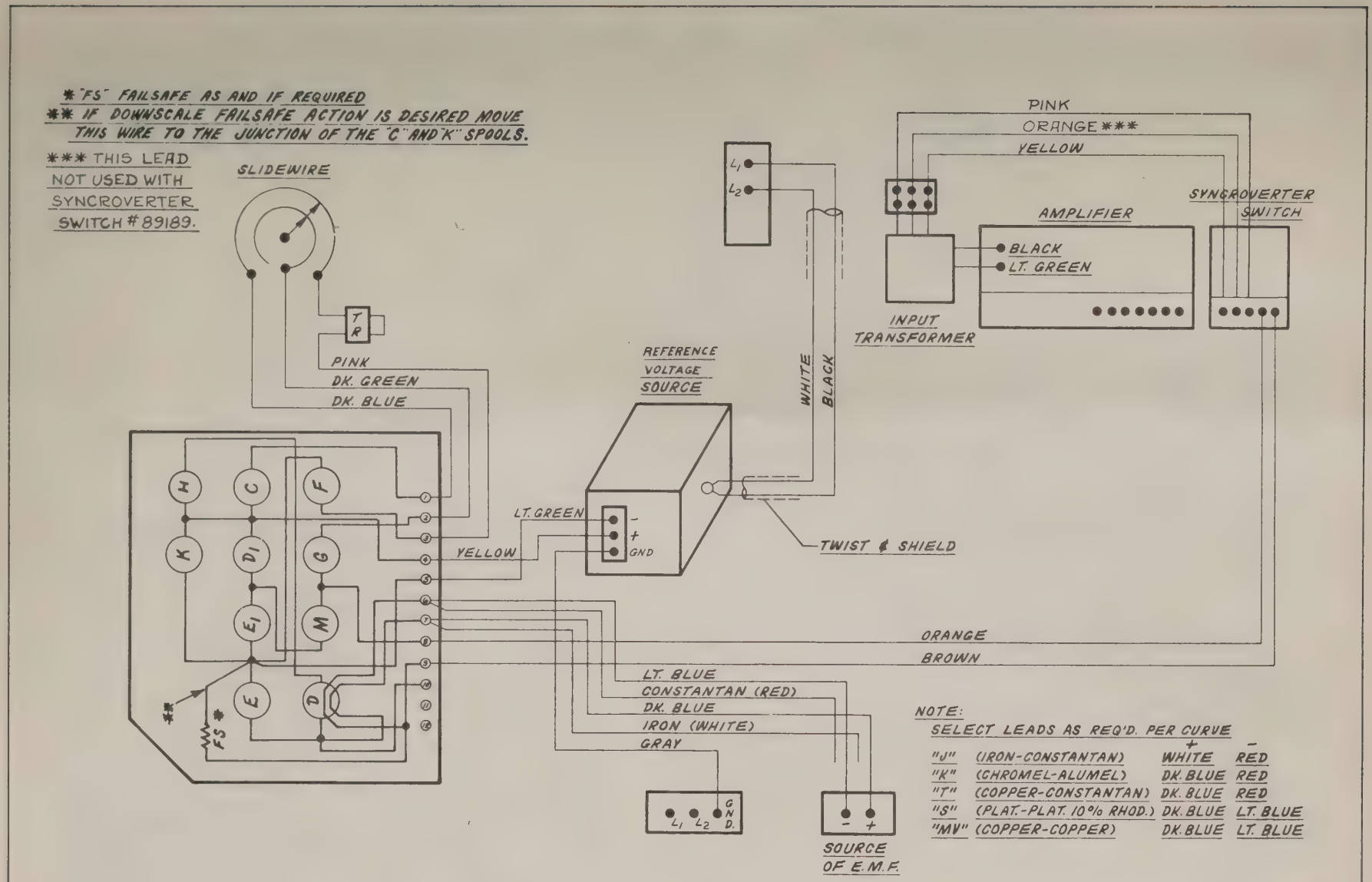


FIGURE 9. MEASURING CIRCUIT WIRING FOR SINGLE-POINT PYROMETER DIVIDER BRIDGE WITH REFERENCE VOLTAGE SOURCE.

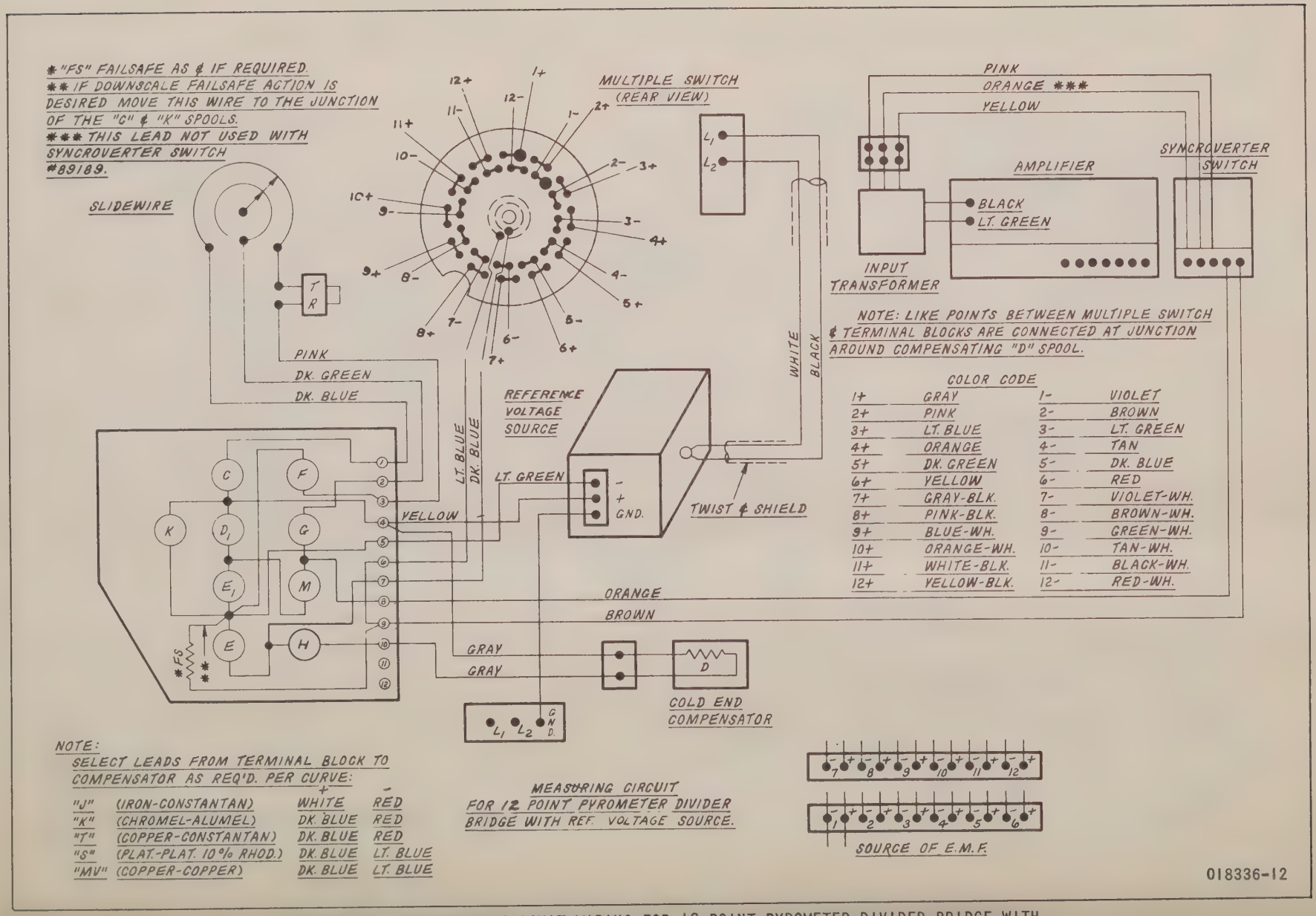


FIGURE 10. MEASURING CIRCUIT WIRING FOR 12-POINT PYROMETER DIVIDER BRIDGE WITH REFERENCE VOLTAGE SOURCE.

INSTRUCTION NO. P12170-7
(Issue of 8/60)

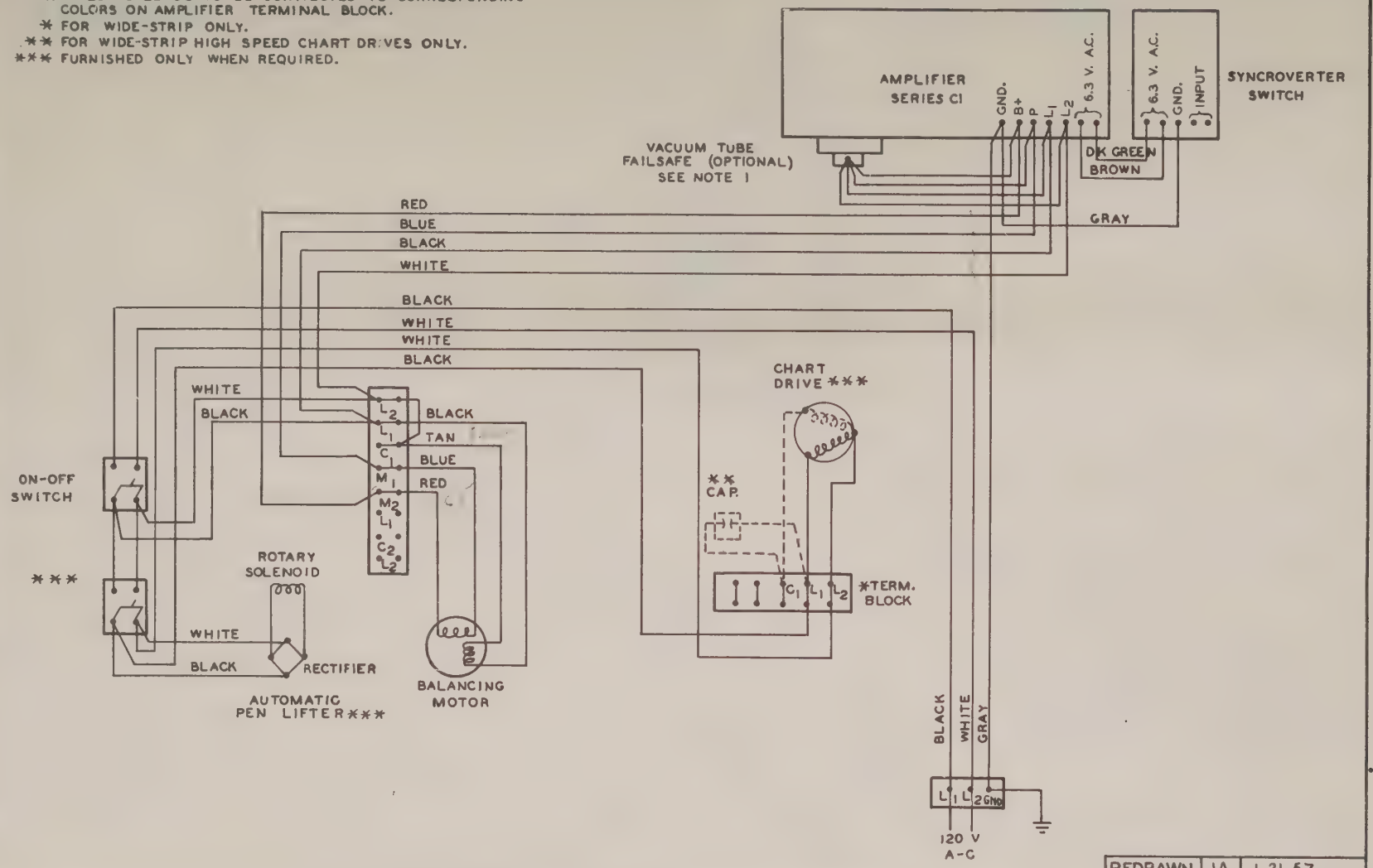
INSTRUCTIONS FOR REPLACING A BATTERY WITH A ZENER VOLTAGE REFERENCE SOURCE

This instruction applies to all Dynamaster bridges using a battery and standard cell and a single pole standardizing unit. These bridges were designed for a voltage of 1.019 across the E spool. See Instruction P12120. These bridges were also designed for a current of .5 milliamps through the C branch and the D branch. The Zener reference unit is designed for an output of 1.019 volts and a current of 3 milliamps. It is first necessary to replace the battery with the Zener source. Then, remove the standardizing unit. Connect the two yellow wires which were on the rheostat together. Connect the orange wire (common) and the dark blue (normally closed) wire on the standardizing relay together. Remove the standard cell, the standard cell resistor, and the two wires connecting these to the bridge. The resistance of the E and F spools will have to be lowered in order to get a current of .5 milliamps through the two branches. Calculate the new E spool as follows: E = 1019 divided by .5 (-D). Calculate the F spool as follows: F = (E + D) -C -X. When the new spools are connected in the bridge, the bridge will draw a current of 1 milliampere. The Zener reference source is designed for a current of 3 milliamperes and will not work properly unless exactly 3 milliamperes is drawn from the source. Therefore, add a K spool connected as a load across the bridge to draw two milliamperes. K = 1019 divided by 2 or 509.5 ohms. This applies to all ranges as described in Instruction P12120.

On most instruments that use a double pole standardizing relay, the bridge originally was designed for 1.019 volts across the bridge. It will not be necessary in this case to change the E and F resistors. The standardizing unit must be removed and the two wires going to the rheostat connected together and the two wires coming from the Syncroverter switch must be connected to the wires which were on the normally closed contacts of the standardizing relay. The standard cell and resistor and connecting wires must be removed. A loading resistor K must be connected across the bridge to draw exactly 3 milliamperes from the Zener reference source. You will find that most of the bridges that use a double pole standardizing unit were special. It will be necessary to check how much current is being drawn by the bridge. This can be done by referring to the lab card or the original calculations for this instrument. When it is determined how much the total current of the bridge is, it is necessary to add a loading spool K across the bridge to draw enough current so that exactly 3 milliamperes is being drawn from The Zener reference source.

The Bristol Company
Waterbury 20, Conn., U.S.A.

NOTES:
1. FAILSAFE LEADS TO BE CONNECTED TO CORRESPONDING COLORS ON AMPLIFIER TERMINAL BLOCK.
* FOR WIDE-STRIP ONLY.
** FOR WIDE-STRIP HIGH SPEED CHART DRIVES ONLY.
*** FURNISHED ONLY WHEN REQUIRED.



POWER CIRCUIT WIRING DIAGRAM

FOR SINGLE-POINT, WIDE-STRIP OR ROUND-CHART D-C DYNAMASTER, FOR USE WITH SERIES CI AMPLIFIER

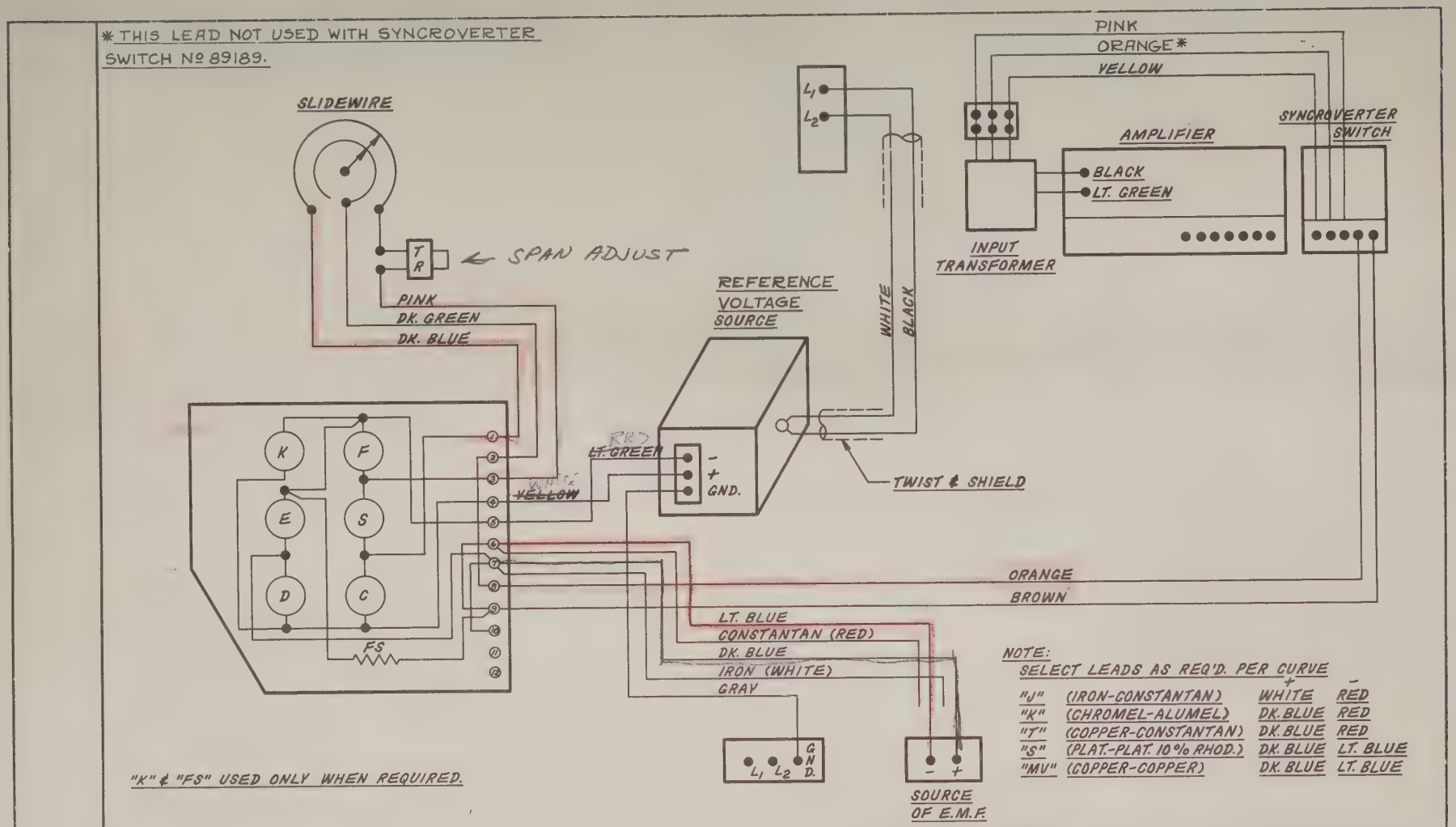
B CO ORDER NO ____ CUSTOMER ORDER NO. ____ SERIAL NO ____

REVISION DATES				
6-16-58	12-12-55	11-13-55	11-9-54	12-20-54
	11-9-56	11-2-55		

REDRAWN	JA	1-21-57

THE BRISTOL COMPANY
WATERBURY CONN U S A.

DRAWN LL TRACED
DATE 9-1-54 DRAWER NO 122
SHEET NO 012683-CI


* THIS LEAD NOT USED WITH SYNCROVERTER SWITCH Nº 89189.
SLIDEWIRE
T
R
SPAN ADJUST
PINK
DK. GREEN
DK. BLUE
REFERENCE VOLTAGE SOURCE
WHITE
BLACK
L1
L2
PINK
ORANGE*
YELLOW
SYNCROVERTER SWITCH
AMPLIFIER
BLACK
LT. GREEN
INPUT TRANSFORMER
K
F
E
S
D
C
FS
LT. GREEN
YELLOW
- + GND.
TWIST & SHIELD
ORANGE
BROWN
LT. BLUE
CONSTANTAN (RED)
DK. BLUE
IRON (WHITE)
GRAY
G N D.
L1 L2
- +
SOURCE OF E.M.F.
"K" & "FS" USED ONLY WHEN REQUIRED.
NOTE:
SELECT LEADS AS REQ'D. PER CURVE
"J" (IRON-CONSTANTAN) + WHITE - RED
"K" (CHROMEL-ALUMEL) DK. BLUE RED
"T" (COPPER-CONSTANTAN) DK. BLUE RED
"S" (PLAT.-PLAT. 10% RHOD.) DK. BLUE LT. BLUE
"MV" (COPPER-COPPER) DK. BLUE LT. BLUE
MEASURING CIRCUIT WIRING DIAGRAM FOR SINGLE POINT MILLIVOLTMETER WITH VOLTAGE REFERENCE SOURCE.
DRAWN B.F.H.
DATE 2-2-60
TRACED B.F.H.
CHECKED
APPROVED
6-1-61
THE BRISTOL COMPANY
WATERBURY CONN U.S.A.
SCALE
NO 018216

THE BRISTOL COMPANY WATERBURY, CONN., U. S. A.

ATTACHMENT SPECIFICATION

NO. T111

INTERCHANGEABLE RANGE CHANGE CARD FOR SINGLE RECORD DYN. RECORDER. (2 PEN DYN. REC. WITH VOLTAGE REFERENCE SOURCE. (ZENER))

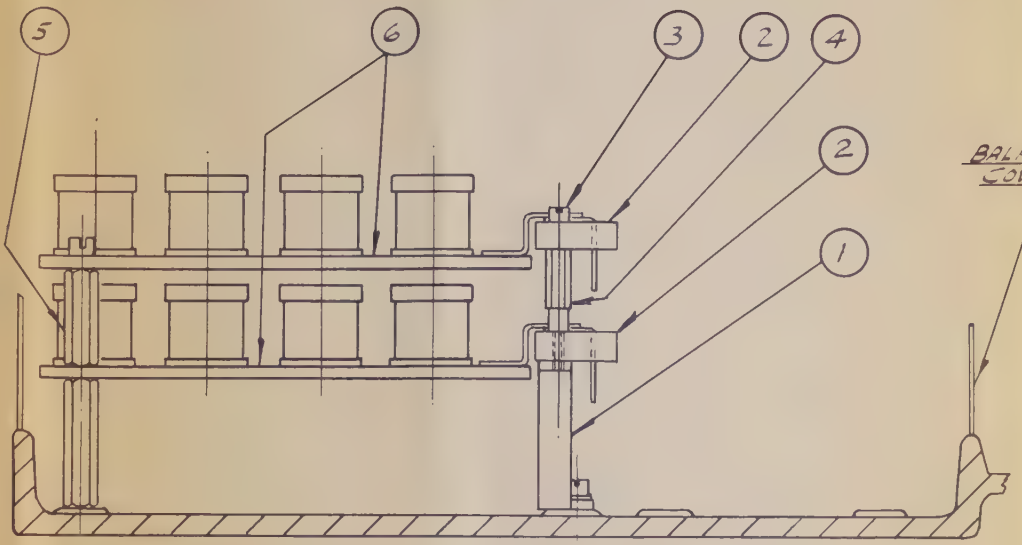
Prod. Memo 83-1165

DRAWN BY	DATE
P.J.G.	3-2-60
CHECKED BY P.J.G.	APPROVED BY

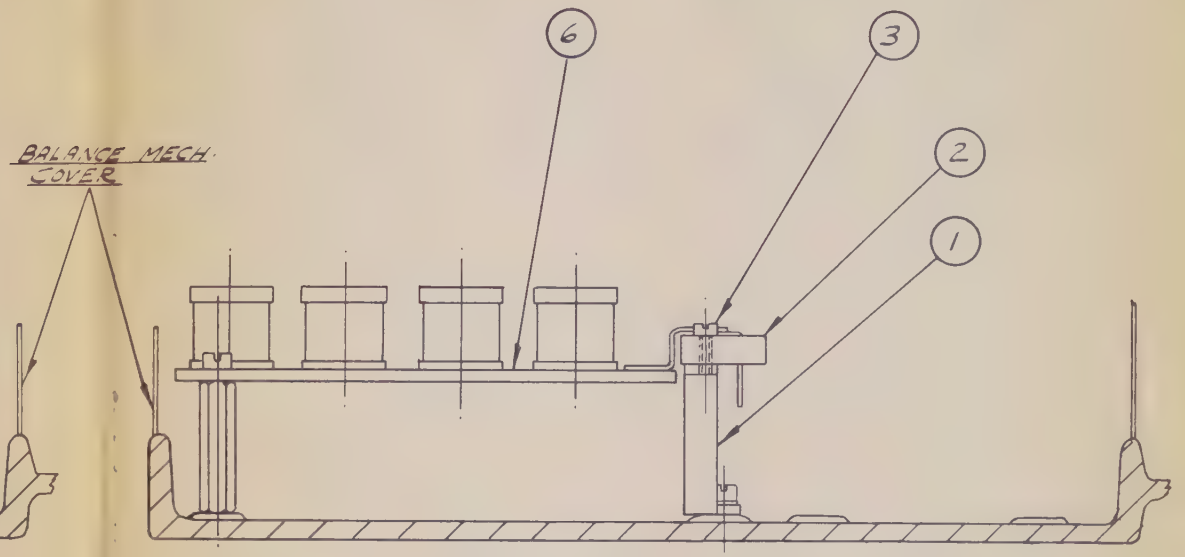
OVERALL DIM.	WIRING DIA.	PROD. MEMO.	ASSEMBLY SHEET	SHEET NO. OF
		Eng. Memo 8465	OB1207	1 1

ITEM	DESCRIPTION	QUAN.	MATERIAL TO BE ORDERED	
	OMIT FROM INSTRUMENT D.S.G.			
	MOUNTING PLATE)(SPOOLS)		A5779	
	POST	2	88141	
	ADD TO INSTRUMENT			
	NOTE: LIST OF MATERIAL FOR USE WHEN (1) RANGE CARD IS SPECIFIED			
1	MOUNTING STRAP		A7136	
2	TERMINAL BLOCK (12 PT.)		A4951	
3	#4-48 x 5/16 FIL.HD.SCR.	2	51556	
4				
5				
6	RANGE CHANGE CARD		A6016	
7	INSERT		A7290	
	SPOOLS (FROM INST. D.S.G. (FOR CALIBRATION)			AS REQ.
	NOTE: LIST OF MATERIAL FOR USE WHEN (2) RANGE CARDS ARE SPECIFIED			
1	MOUNTING STRAP		A7136	
2	TERMINAL BLOCK (12 PT.)	2	A4951	
3	#4-48 x 5/16 FIL.HD.SCR.	2	51556	
4	POST (TERMINAL BLOCK)	2	A7137	
5	POST (RANGE CARD)	2	95609	
6	RANGE CHANGE CARD	2	A6016	
7	INSERT		A7290	
	SPOOLS (FROM INST. D.S.G.) (FOR CALIBRATION)			

NOTE: WHEN ATT. T111 IS USED IN THE #2 PEN POSITION ADD WASHER #95424 QUAN (6), 2 UNDER EACH POST & (1) ON TOP OF EACH POST. ALSO ADD #6-40 DRILL HOLES IN MTG. PLATE (SPOOLS)



ARRANGEMENT OF MATERIAL WHEN
2 RANGE CARDS ARE SPECIFIED



ARRANGEMENT OF MATERIAL WHEN
1 RANGE CARD IS SPECIFIED

FOR LIST OF MATERIAL
SEE ATTACHMENT SPEC. T 111

LTR.	REVISION	DATE	S.C.R.

DEFIANCE 35118

DO NOT SCALE THIS PRINT

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE AFTER PLATING
EDGES AND CORNERS .005" TO .010" NOM. RAD.
TOLERANCES-FRACTIONS ± 1/64" DECIMALS ± .005"
ANGLES ± 2°

INTERCHANGEABLE RANGE CHANGE SPOOL CARD FOR DYNAMASTER RECORDER

THE BRISTOL COMPANY
WATERBURY 20, CONN., U.S.A.

DR'N. R.L.C.	DATE 3-10-60		
TRC'D.	CHECKED	APP'D.	
DES. LOMBARDO			
PROD. DRN.			
SCALE FULL	FILE DR. 08		
NO. 08/207			

Instruction W-18220
Issued April 1954

HOW TO ORDER PARTS AND SUPPLIES

FOR BRISTOL PRODUCTS

In all correspondence concerning any product of the Bristol Company, always give the model and serial number of the product concerned. Send your purchase order or quotation request to the nearest Bristol Company Branch Office (see the back of this sheet for addresses).

REPLACEMENT PARTS

When ordering replacement parts look up the part name and number in the parts list provided with the instructions that came with your product. When you cannot find a part number, give an accurate description of the part. If you have mislaid your parts list write for a new one giving the model and serial number of the product.

CHARTS

In ordering charts for recorders, give the chart number (printed on the chart and also on the instrument name plate).

Avoid inconvenient emergency orders by keeping a six months supply of charts on hand for each of your recorders.

THERMOCOUPLES

Pyrometer thermocouples should be ordered from Bulletin P-1238. Be sure to specify the catalog number and the length. If you do not have Bulletin P-1238, write for one.

Pyrometer users should always have a supply of spare thermocouples.

SAMPLE PURCHASE ORDER:

QUANTITY REQUIRED	DESCRIPTION	PART, CHART OR CATALOG NUMBER
1000	Charts, 0° to 1500°F	5342
5	7-day electric chart drive for 115 volts, 60 cycles	86226
4	Pen arms marked CD	49703
1	Knurled plastic knob on outside of case, ½" diameter, 3/16" hole for moving set-point index	none given
1	1 oz. bottle red ink	6883
	The above parts are for a Bristol thermometer controller Model 1T1X500B-2, serial number 767211.	
4	IC thermocouples, length 30"	3BS14N2
	The above thermocouples are for a Bristol pyrometer Model 487-L, serial number 202953	

THE BRISTOL COMPANY · Waterbury 20, Conn.

A SUBSIDIARY OF AMERICAN CHAIN AND CABLE CO. INC.

BRANCH OFFICES

ALABAMA
Birmingham 3, 1021 Comer Building ..... Alpine 1-0034

CALIFORNIA
Los Angeles 22, 6800 East Acco Street ..... Raymond 3-9751
San Diego 15, 5606 El Cajon ..... Juniper 3-2971
San Francisco 7, 40 Berry Street ..... Garfield 1-0223

COLORADO
Denver 16, 4555 East 46th Avenue ..... Dexter 3-6228

CONNECTICUT
Hartford ..... Jackson 7-2377
Waterbury 20, Bristol Road 756-4451

DELAWARE
Wilmington, 374 Delaware Trust Bldg. ..... Olympia 2-3166

DISTRICT OF COLUMBIA
Washington ..... Enterprise 1-5400

FLORIDA
St. Petersburg, 945 Central Ave. ..... Orange 1-5151

GEORGIA
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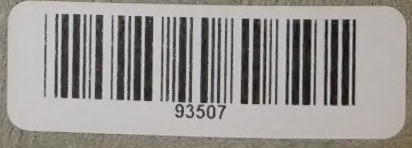
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